INDIAN AND NORTHERN AFFAIRS CANADA

NORTHERN AFFAIRS PROGRAM

SUMMARY REPORT:

DRILLING FLUID USE AND WASTE DISCHARGE

IN

ARCTIC MARINE WATERS NORTH OF 60^{0}

FOR

1984

Water Resources Division

July 1986

SUMMARY

Hydrocarbon exploration operators working offshore in the Canadian Arctic are required to report to COGLA various data on drilling fluid additives and wastes discharged to the arctic marine environment. This report is the third in a series produced by Arctic Waters, Water Resources Division of the Department of Indian Affairs and Northern Development.

This report summarizes the data reported by four (4) operators active in hydrocarbon exploration in arctic marine waters North of 60^{o} for the year 1984. Problem areas have been identified and recommendations made for further compilation of data for future annual summary reports.

Milburn, D. and D.L.S. Edwards, 1986, "Summary Report: Drilling Fluid Use and Wastes Discharge in Arctic Marine Waters North of 60^{o} for 1984." Arctic Waters Section, Water Resources Division, Northern Affairs Program, Indian and Northern Affairs Canada, Yellowknife, N.W.T., 49 pages.

ACKNOWLEDGEMENTS

The Authors acknowledge the assistance given during the preparation of this report especially the typing services of Ms. Maxine Vick and the drafting provided by Mr. Mark Fisher.

Contents

Page

Summary.....(i)

Acknowledgements.....(ii)

Table of Contents.....(iii)

List of Tables.....(iv)

List of Figures.....(vi)

1. Introduction..... 1

2. Background..... 4

3. Observations..... 9

4. Discussions and Recommendations..... 10

5. References..... 11

6. Appendix I. Water Based Drilling 12
Fluid Additives used by
One or More Operator

Oil Based Drilling Fluid
Additives used by
Panarctic Oils Limited 16

7. Appendix II. Tables..... 17

8. Appendix III. Figures showing Line of 40
Best Fit for selected
Drilling Fluid Additives
and Well Depth

LIST OF TABLES

		Page
Table 1	Physical Data for Wells Drilled in Arctic Marine Waters North of 60° - 1984	18
Table 2	Dome Petroleum Limited Drilling Fluid Additive Use by Well	20
Table 3	Esso Resources Canada Ltd. Drilling Fluid Additive Use by Well	21
Table 4	Gulf Canada Resources Inc. Drilling Fluid Additive Use by Well	22
Table 5a	Panarctic Oils Ltd. Drilling Fluid Additive Use by Well	23
Table 5b	Panarctic Oils Ltd. Drilling Fluid Additives used to Formulate the Diesel Oil Based Mud	24
Table 6a	Dome Petroleum Limited Comparison of Estimated and Actual Drilling Fluid Additive Use	26
Table 6b	Dome Petroleum Limited Percentage Differences Between Estimated and Actual Additive Use	27
Table 7a	Esso Resources Canada Ltd. Comparison of Estimated and Actual Drilling Fluid Additive Use by Well	28
Table 7b	Esso Resources Canada Ltd. Percentage Differences Between Estimated and Actual Additive Use	29
Table 8a	Gulf Canada Resources Inc. Comparison of Estimated and Actual Drilling Fluid Addivite Use by Well	30
Table 8b	Gulf Canada Resources Inc. Percentage Differences Between Estimated and Actual Additive Use	31
Table 9a	Panarctic Oils Ltd. Comparison of Estimated and Actual Drilling Fluid Additive Use by Well	32

Table 9b	Panarctic Oils Ltd. Percentage Differences Between Estimated and Actual Additive Use	33
Table 10	Dome Petroleum Limited Drilling Waste Summary by Well	35
Table 11	Esso Resources Canada Ltd. Drilling Waste Summary by Well	36
Table 12	Gulf Canada Resources Inc. Drilling Waste Summary by Well	37
Table 13	Panarctic Oils Ltd. Drilling Waste Summary by Well	38
Table 14	Major Drilling Fluid Additives with Toxicity (LC50) of 1000 ppm or less used in Arctic Marine Waters North of 60^{0} - 1984	39

LIST OF FIGURES

Page

Figure 1 Location of Wells - Beaufort Sea
Dome Petroleum Limited,
Esso Resources Canada Ltd., and
Gulf Canada Resources Inc. 5

Figure 2 Location of Wells - High Arctic Islands
Panarctic Oils Ltd. 6

Figure 3 Total Barite Use by Well
with Line of Best Fit 41

Figure 4 Total Bentonite Use by Well
with Line of Best Fit 42

Figure 5 Total Caustic Soda Use by Well
with Line of Best Fit 43

Figure 6 Total KCl/Potash Use by Well
with Line of Best Fit 44

Figure 7 Total Soda Ash Use by Well
with Line of Best Fit 45

Figure 8 Total Bicarbonate of Soda Use by Well
with Line of Best Fit 46

Figure 9 Total XC Polymer (Includes XCL, XCD)
Use by Well with Line of Best Fit 47

1. INTRODUCTION

Hydrocarbon exploration companies conducting operations on Canada Landsare required to obtain an Authority to Drill a Well (ADW) issued by the Canada Oil and Gas Lands Administration (COGLA) under the authority of the Canada Oil and Gas Act (COGA). Attached to the ADW for offshore wells North of 60^0 are Environmental Operating Conditions (EOC) provided by the Northern Affairs Program (NAP) of the Department of Indian Affairs and Northern Development (DIAND). The EOC are developed through consultation with the Arctic Water Advisory Committee (AWAC), an interdepartmental committe with public representation. The EOC require an operator to submit to COGLA prior to spud date, a list of drilling fluid additives and base materials anticipated for use in the drilling fluid program and the expected mass or volume of each component. Through consultation with NAP and AWAC, the Conservation Engineer (COGLA) approves the use of the drilling fluid additives submitted by the operator.

In 1984 through an initiative by Gulf Canada Resources Inc. a master list of drilling fluid additives was produced to assist both industry and regulators in assessing drilling fluid additives. The list was a compilation of all previously approved drilling products for use in the Beaufort Sea. Supporting information included the chemical description of the product, its function, its projected rate of usage or total quantity to be used, LC_{50}, and Canadian distributor of the product.

Prior to implementation of this master list, all drilling fluid additives had to be approved by the Conservation Engineer on an annual basis. The ultimate objective of using the master list was to allow the operators in the Beaufort Sea more flexibility in deviating from a stringent list of additives approved for a single well. Any product not found on the list would still be subject to COGLA approval.

The EOC also require the operator to report after rig release, data on waste discharges. A typical EOC in this requirement is as follows:

The Operator shall determine the total volume of drilling wastes and muds deposited into arctic waters and submit a report to the Conservation Engineer within ninety (90) days of rig release that shall include but not be limited to the following:

a) the daily and total volume of drilling wastes discharged;

b) the volume of mud tank contents discharged and the date and reason for discharge;

c) The total mass of each mud additive, specialty compound or other products used in the mud system including the type and amount of oil from all sources entering the drilling fluid; and

d) the volume of hydraulic fluid (generally a glycol mixture) discharged to arctic waters during the operation of the Blowout Preventor stack and the date of each discharge.

It is noted that the last requirement is applicable only to drillships or other floating platforms that have the BOP on the ocean floor.

The intent of this series of reports is to compile and reduce the data reported by the operators as a requirement of the EOC. Comparisons of anticipated and actual drilling fluid use are made, as well as total waste discharges from each wellsite. This information can assist resource managers in predicting potential effects from offshore hydrocarbon exploration activities.

In 1985, a computerized database for historical drill wastes was developed by Environmental Sciences Limited, Sidney, B.C. for the Department of Fisheries and Oceans, the Department of Indian Affairs and Northern Development, the Department of Environment and the Canada Oil and Gas Lands Administration. The "Compilation of Historical Drill Waste Data Associated with Exploratory Drilling in the Canadian Beaufort Sea, Arctic Islands and Davis Strait Regions" records a great majority of all drilling waste

information for exploratory wells prior to 1985. Tour sheets and well history records from COGLA files in Yellowknife were scrutinized and appropriate information extracted for the database compilation (Turney et al, 1986).

The annual reports prepared by the Water Resources Divison differ from this compilation in the course of data, the comparison of estimated and actual usage of drilling fluid additives and the statistical analyses of selected data. Another important difference between the two reports is that this series of reports provides the actual volumes and types of wastes discharged from each well. These annual reports will complement the historical database.

2. BACKGROUND

Sixteen (16) wells were drilled in 1984 by the four (4) operators active in hydrocarbon exploration offshore in the Canadian Arctic. The operators and the wells drilled were:

1. Dome Petroleum Limited, Calgary, Alberta

    Aiverk 2I-45
    Arluk E-90
    Havik B-41
    Natiak O-44
    Nerlerk J-67
    Suiluk I-05

2. Esso Resources Canada Limited, Calgary, Alberta

    Adgo H-29
    Amerk O-09
    Nipterk L-19

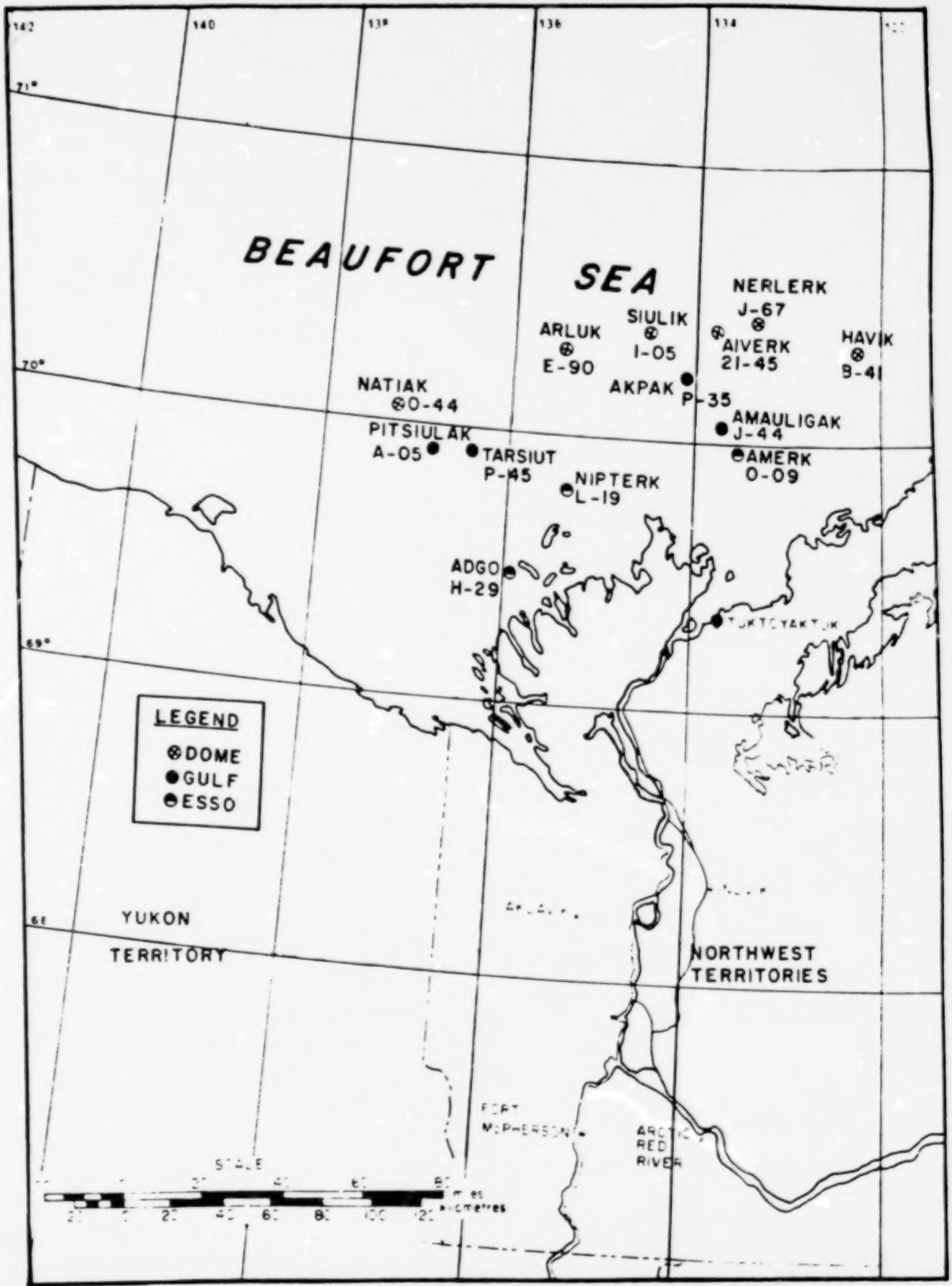
3. Gulf Canada Resources Inc., Calgary, Alberta

    Akpak P-35
    Amauligak J-44
    Pitsiulak A-05
    Tarsiut P-45

4. Panarctic Oils Limited, Calgary, Alberta

    Buckingham B-69
    Cisco M-22
    Skate C-59

The locations of these wells are shown in Figures 1 and 2 while Table 1 provides the location and depths of the wells.


142
140
138
136
134
71°
70°
69°
BEAUFORT SEA
NERLERK
J-67
SIULIK
I-05
ARLUK
E-90
AIVERK
21-45
HAVIK
B-41
NATIAK
O-44
AKPAK
P-35
AMAULIGAK
J-44
PITSIULAK
A-05
TARSIUT
P-45
AMERK
O-09
NIPTERK
L-19
ADGO
H-29
TUKTOYAKTUK
LEGEND
DOME
GULF
ESSO
YUKON
TERRITORY
NORTHWEST
TERRITORIES
FORT
MCPHERSON
ARCTIC
RED
RIVER
SCALE

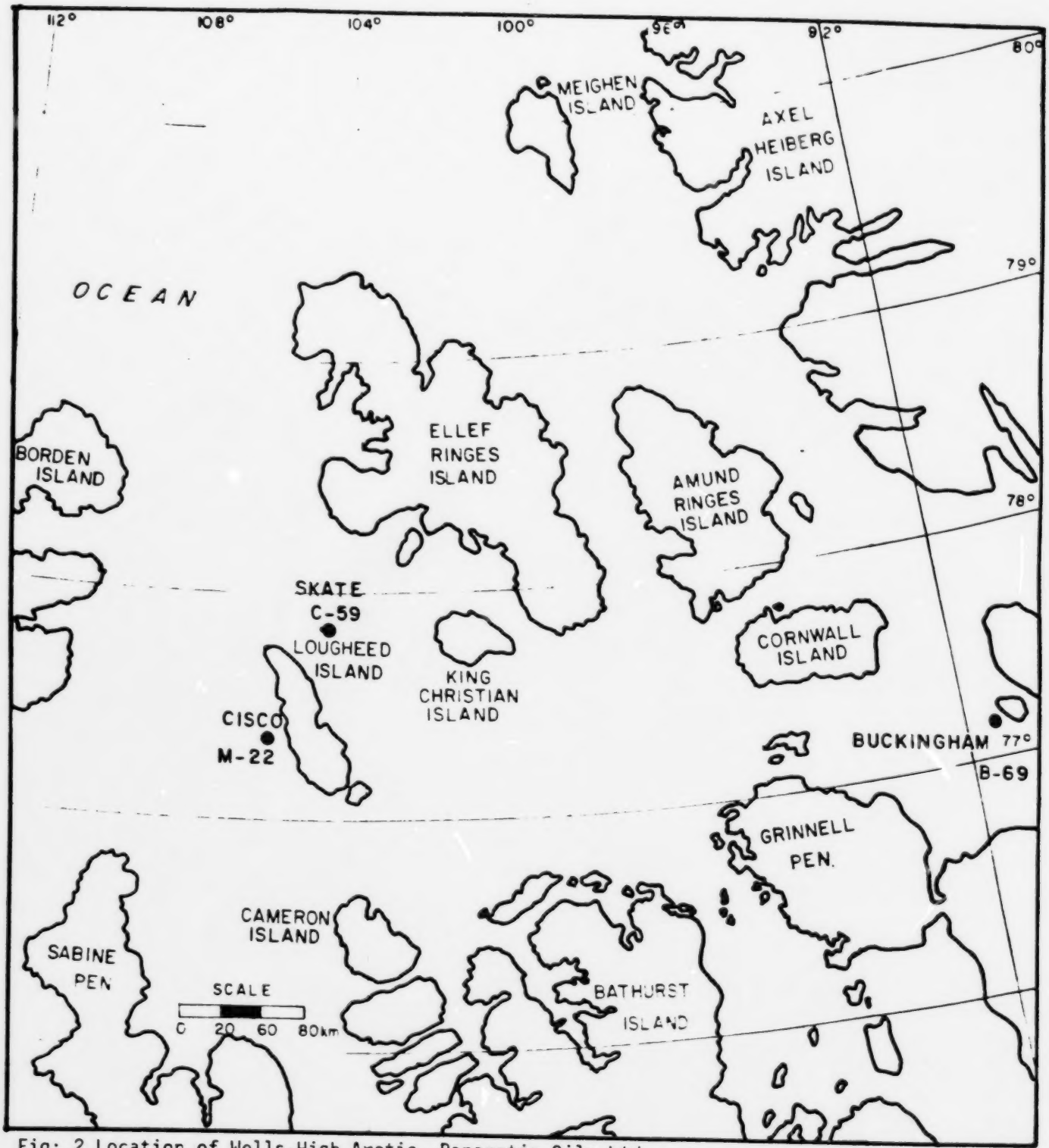


Fig: 2 Location of Wells-High Arctic- Panarctic Oils Ltd.

In February 1984, Panarctic Oils Limited used a diesel oil based mud while coring a sandstone horizon at their Cisco M-22 wellsite. This was the first use of an oil based mud offshore in the Canadian Arctic.

Approval to use the diesel based mud was based on Panarctic's commitment to use a closed loop system with no discharge to the marine environment. Used mud was incinerated in a sump at Lougheed Island in accordance with the Land Use Regulations of the NWT. The operator did not experience difficulty in the use of the Turbo A-1 diesel based mud but problems were incurred with the incineration operation (Milburn 1984 and Panarctic 1984).

The drilling fluid additives used to formulate the diesel oil based mud are listed in Table 5b.

In the two previous reports prepared by Arctic Waters, Water Resources Division (Milburn and Edwards 1985 and Evans and Milburn 1984) these compilation and summary reports serve as a first step in data reduction. Limited statistical analyses were conducted on data submitted for 1983. Regression analysis of major fluid components and well depth showed positive correlation albeit not strong due to small sample size and the wide variety of factors downhole which affect the final mud composition. Similar analysis has been conducted for this report using data for 1983 and 1984.

The major drilling components subjected to simple linear regression were barite, bentonite, bicarbonate of soda, caustic soda, KCl/potash, soda ash and XC polymer. These components were chosen as they are used in all wells drilled in the arctic and are used extensively in all phases of the well program. The lines of best fit and their formulae are shown in Figures 3 to 9.

The data submitted by the four hydrocarbon exploration operators for 1984 are grouped in the following tables:

1. Summaries of Drilling Fluid Additive Use by Well - Tables 2-5b;

2. Comparison of Estimated and Actual Drilling Fluid Additive Used - Table 6-9; and

3. Summary of Drilling Waste by Well - Tables 10-13.

The major drilling fluid additives that exhibit an acute toxicity LC_{50} (96 hour) of 1000 ppm or less are listed in Table 14.

In an effort to ease interpretation of the tabular summaries, Appendix I provides an alphabetical list of all drilling fluid additives reported by one or more operator, and a grouping of these additives showing the most common designation and other frequently used names.

The drilling fluid usage and waste discharge reports, supplied by the companies, were generally of higher quality than those previously received. There was the occassional tendency to make the information very general. For example, reporting a gel being used without indicating its composition. Matters such as these proved to be easily cleared up when the company was contacted.

3. OBSERVATIONS

1. Most data were reported in S.I. units and summary sheets of the data made available. This allowed for easier compilation of this report.

2. There is some positive correlation between the mass of major drilling fluid additives used and the depth of the well. The additives used to the greatest extent were barite, KCl, caustic soda, soda ash, and sodium bicarbonate. Other additives were used less frequently and no real trend is exhibited as their use is dependent on downhole conditions.

3. The greatest source of waste discharges was designated "solids control/cuttings" (material generated through the act of drilling the hole). The quantity of mud is the second greatest source while hydraulic fluids and other wastes were a distant third.

4. Estimates of additive use and actual additive use, except in some isolated cases, were not in agreement. When the two values are compared, there is a wide gap between what was stockpiled in anticipation and what was actually used.

5. The use of diesel and other low LC_{50} additives is fairly extensive. Most of the additives (e.g. diesel, caustic soda, Turbo fuel, Torq Trim, Torq Kontrol) are used to control pH or sticking downhole. The remainder of the additives are used less frequently and often in small quantities. Except for diesel and other fuels, the use of which is undergoing regulatory review, these additives will probably continue to be used in the future.

4. DISCUSSION AND RECOMMENDATIONS

1. To overcome problems incurred in assembling incomplete or inaccurate data, the reported data must be reviewed upon receipt and discrepancies addressed immediately to the operator.

2. As the data base expands for the information presented in this report and subsequent reports, further treatment of the data is recommended.

3. It is recommended that the Arctic Waters Section, Water Resources Division, NAP, INAC, continue to compile these summary reports.

4. It is recommended that the EOC requiring the submission of reports for anticipated and actual drilling use and waste discharge be retained.

5. Given the inaccuracies in the estimates of projected additive use by the companies, it is suggested that persons receiving these estimates consider that they are derived from best guesses and cannot accurately reflect all possible conditions downhole. These conditions can and do play havoc with the estimates.

REFERENCES CITED

1. Tourney, L., J.W. MacDonald, T. Sackmann and E. Svendsen, 1985. "Compilation of Historical Drill Waste Data Associated with Exploratory Drilling in the Canadian Beaufort Sea, Arctic Islands and Davis Strait." Prepared by ESL Environmental Sciences Limited for Department of Fisheries and Oceans, Department of Indian Affairs and Northern Development, Department of Environment, and Canada Oil and Gas Lands Administration. Unpublished Manuscript.

2. Milburn, D., "Use of Diesel Oil Based Muds at Panarctic Oils Limited's Cisco M-22 Wellsite, High Arctic Islands, NWT", Department of Indian Affairs and Northern Development, Yellowknife, NWT, Internal Report, 1984,

3. Panarctic Oils Limited, "Report on Panarctic et al Cisco M-22 Invert Drilling Fluid", Panarctic Oils Limited, Calgary, Alberta, 1984.

4. Milburn, D. and D.L.S. Edwards, "Summary Report: Drilling Fluid Use and Waste Discharge in Arctic Marine Waters North of 60° for 1983", Department of Indian Affairs and Northern Development, Yellowknife, NWT, Internal Report, 1985.

5. Evans, T.B. and D. Milburn, "Drilling Mud Usage and Discharge in Arctic Marine Waters North of 60° for the Period 1978-1982", Department of Indian Affairs and Northern Development, Yellowknife, NWT, Internal Report, 1985.

5. APPENDIX I

DRILLING FLUID ADDITIVES REPORTED
BY ONE OR MORE OPERATOR

Water Based Drilling Fluid Additives Used by One or More Operator

Drilling Fluid Additive	Primary Function
Aluminium Stearate	Defoamer
AP-21	Filtrate Reducer
Attapulgite Gel	Viscosifier
Barazan	Viscosifier
Bardac 2250	Bactericide
Barite	Weighting Material
Bentonite	Viscosifier, Filtrate Reducer
B-Free; regular, heavy wate	Surfactant, Lubricant
Bicarbonate of Soda	Calcium Treating
Calcium bromide	Packing Fluid
CaCl	Freeze Depressant, Cement Accelerator
Capryl Alcohol	Defoamer
Caustic Soda	pH Control
Carbonox	Filtrate Reducer, Dispersant
Cellophane	Filtrate Reducer
Chrome Alum	Lost Circulation Material
CMC	Filtrate Reducer
Coat 129	Corrosion Inhibitor
Coat 888	Corrosion Inhibitor
Defoamer	Defoamer
Densimix	Weighting Material
Desco	Thinner
DF-Vis	Filtrate Reducer, Viscosifier
Diesel	Lubricant
Drispac - Reg., Superlo	Filtrate Reducer, Viscosifier
DX-10	Surfactant
Foam Kontrol	Surface Active Liquid Defoamer
FLR-100 (FLR-100E)	Lost Circulation Material
Friction Ease	Lubricant

Gel (Bentonite)	Filtrate Reducer, Viscosifier
Gilsonite	Lost Circulation Material, Shale Control
IDFlo	
IDF-Thin	Lost Circulation Material
Imco Fibre	Dispersant
	Lost Circulation Material
KID-97	Viscosifier
Kelzan XC/XCD/XCL	Viscosifier
Kwik Seal	Lost Circulation Material
Lignite	Filtrate Reducer
Lime	pH Control
Lubraglide	Lubricant
Magconol	Defoamer
Magco Foam Chek	Defoamer
Mica	Lost Circulation Material
Nickel Salt	Catalyst for Oxygen Scavenger
Nickel Sulphate	Catalyst for Oxygen Scavenger
Noxygen	Corrosion Inhibitor
Nut Hulls	Lost Circulation Material
Nut Plug	Lost Circulation Material
Paraformaldehyde	Bactericide
Peltex	Thinner, Dispersant
Poly Rx	Dispersant
Potassium Chloride (KCl)	Shale Inhibitor, Freeze Depressant
Potash	Shale Inhibitor, Freeze Depressant
Safeguard 5000	
Salt	Flocculent
SAPP	Thinner, Dispersant
Sawdust	Lost Circulation Material
Shale Kontrol	Corrosion Inhibitor

SMR	Viscosifier
Soda Ash	Calcium Treating
Sodium Bicarbonate	Calcium Treating
Sodium Nitrate	Tracing Fluid
Sodium Sulphite (Sulfite)	Corrosion Inhibitor
Soltex	Mud Conditioner
Spersene	Filtrate Reducer, Dispersant
SST	Shale Inhibitor
Staflo-XLo, reg.	Filtrate Reducer
Surflo W-300	Defoamer
Surflo H-35	Scale Inhibitor
Tannathin	Thinner, Dispersant
Techniflo	Fluid Loss Control
Technisperse Dispersant	Fluid Loss Control
Torq Kontrol	Lubricant
Torque Less Beads	Lubricant
Torque Trim	Lubricant
Torque Trim II	Lubricant
Turbo A-1	Lubricant
Unical	Thinner, Dispersant
Walnut Hulls	Lost Circulation Material
Xpel G.	Shale Inhibitor
XC Polymer (XCD, XCL included)	Viscosifier (see also Kelzan)
Zeogel	Viscosifier

Oil Based Drilling Fluid Additives Used by Panarctic Oils Limited

Drilling Fluid Additive	Function
Normul	Emulsifier
Primul	Emulsifier/Fluid Loss Control
Technireg	Emulsifier
Technisurf	Thinner
Technivis	Viscossifer

6. APPENDIX II

TABLES

TABLE 1: PHYSICAL DATA OF WELLS

DRILLED IN ARCTIC MARINE WATER

NORTH OF 60° 1984

Well Name	Latitude/Longitude	Depth(m)
Dome Aiverk 2I-45	77° 24' 44" N 133° 42' 21" W	5034
Dome Arluk E-90	70° 19' 23" N 135° 26' 31" W	4300
Dome Havik B-41	70° 20' 11" N 132° 13' 05" W	4750
Dome Natiak O-44	70° 03' 57" N 137° 13' 07" W	4650
Dome Nerlerk J-67	70° 26' 42" N 133° 19' 29" W	2367
Dome Siulik I-05	70° 24' 38" N 134° 30' 40" W	4824
Esso Adgo H-29	69° 28' 23" N 135° 50' 21" W	3314
Esso Amerk O-09	69° 58' 56" N 133° 30' 51" W	5000
Esso Nipterk L-19	69° 48' 38" N 135° 19' 53" W	3879
Gulf Akpak P-35	70° 14' 52" N 134° 09' 22" W	2169
Gulf Amauligak J44	70° 03' 31" N 133° 42' 45" W	4002
Gulf Pitsiulak A-05	69° 54' 14" N 136° 45' 35" W	2192
Gulf Tarsiut P-45	69° 54' 55" N 136° 25' 04" W	3042
Panarctic Buckingham B-69	77° 08' 02" N 91° 23' 38" W	2772
Panarctic Cisco M-22	77° 22' 05" N 106° 10' 54" W	2367
Panarctic Skate C-59	77° 48' 15" N 104° 51' 28" W	2300

Source: The Canada Oil and Gas Lands Administration Annual Report, 1984, pages 32-35.

SUMMARIES OF DRILLING FLUID ADDITIVE

USED BY WELL

TABLE 2: DOME PETROLEUM LIMITED

DRILLING FLUID ADDITIVES USED BY WELL

(all measures are in kg unless otherwise indicated)

ditive	Aiverk 21-45	Arluk E-90	Havik B-41	Natiak O-44	Nerlerk J-67	[illegible]-05	Total
luminum Stearate	-	-	-	-	-	125.0	125.0
21 (1)	-	12,760.0	3,580.0	2,880.0	2,820.0	1,560.0	23,600.0
21 (solid)	-	1,200.0	-	-	-	-	1,200.0
arite (tonnes)	819.0	2,276.0	3,505.0	580.0	739.0	909.0	8,828.0
entonite	9,435.0	63,050.0	53,890.0	31,008.0	-	19,731.0	177,114.0
free (1)	-	-	208.0	-	-	-	208.0
arbonate of Soda	3,266.0	1,769.0	3,723.0	227.0	907.0	1,225.0	11,117.0
rine (1)[a]	-	-	-	-	105,000.0	-	105,000.0
istic Soda	2,925.0	12,725.0	30,200.0	6,575.0	3,515.0	7,053.0	62,993.0
oamer (1)	-	-	-	-	-	2,050.0	2,050.0
ensimix	50,000.0	-	-	-	-	-	50,000.0
esco	-	3,413.0	-	-	-	1,270.0	4,683.0
spac/Staflo Reg.	-	1,400.0	3,587.0	-	-	318.0	5,305.0
spac Superlo	748.0	4,666.0	7,423.0	1,861.0	4,264.0	771.0	19,733.0
X 10 (1)	-	-	5,408.0	3,744.0	10,000.0	2,496.0	21,648.0
R 100	-	-	-	-	-	100.0	100.0
m Kontrol (1)	-	-	7,904.0	1,040.0	200.0	-	9,144.0
Flo	-	-	10,200.0	-	12,750.0	-	22,950.0
F Thin	2,676.0	44,950.0	-	-	-	-	47,626.0
	29,250.0	66,475.0	142,800.0	4,750.0	106,750.0	49,375.0	399,400.0
zan (XC, XCD)	775.0	1,513.0	2,075.0	275.0	7,475.0	341.0	12,454.0
wik Seal	581.0	13,061.0	747.0	-	-	-	14,389.0
conol (1)	416.0	624.0	832.0	416.0	-	-	2,288.0
a	-	13,700.0	2,497.0	-	-	50.0	16,247.0
ygen	-	250.0	1,362.0	-	-	-	1,612.0
ut Plug	522.0	-	-	136.0	-	-	658.0
y Rx	-	-	-	5,448.0	-	3,084.0	8,532.0
P	726.0	-	500.0	-	-	680.0	1,906.0
Shale Kontrol	-	-	-	-	3,750.0	-	3,750.0
a Ash	544.0	2,087.0	9,580.0	454.0	6,486.0	-	19,151.0
ium Sulfite	454.0	-	-	363.0	300.0	475.0	1,592.0
oltex	3,425.0	-	-	-	-	-	3,425.0
(1)	-	-	26,809.0	-	-	-	26,809.0
flo EX-Lo	3,450.0	2,900.0	8,354.0	2,375.0	-	-	17,079.0
echnisperse	3,084.0	-	51,823.0	17,116.0	150.0	27,170.0	99,343.0
orqless Bead	-	-	386.0	-	-	1,225.0	1,611.0
q Kontrol (1)	-	-	-	-	-	7,280.0	7,280.0
q Trim (1)	-	12,110.0	12,272.0	3,328.0	-	5,824.0	33,534.0
Walnut Hulls	-	10,175.0	-	-	-	-	10,175.0
el-G	-	3,200.0	3,632.0	-	-	4,921.0	11,753.0

[a] chemical/salt content of brine not indicated

TABLE 3: ESSO RESOURCES CANADA LIMITED

DRILLING FLUID ADDITIVE USE BY WELL

(all measures are in kg unless otherwise indicated)

Additive	Adgo H-29	Amerk O-09	Nipterk L-19	Total
Aluminum Stearate	50.0	622.7	580.0	1,252.7
Barazan	-	-	589.0	589.0
Barite (tonnes)	204.0	2,108.0	1,102.0	3,414.0
Bentonite	12,122.0	53,195.0	18,158.0	83,475.0
B-free (l)	1,045.0	120.0	5,581.0	6,746.0
Bicarbonate of Soda	5,176.0	2,675.0	9,757.0	17,608.0
Caustic Soda	8,450.0	25,770.0	20,284.0	54,504.0
CMC	50.0	-	1,900.0	1,950.0
Diesel (l)	60,411.0	-	36,262.0	96,673.0
Drispac - Regular	2,088.0	6,162.0	21,013.0	29,263.0
- Superlo	-	4,994.0	-	4,994.0
IDFlo	-	22,325.0	13,365.0	35,690.0
KCL	27,250.0	59,851.0	12,150.0	99,251.0
Kelzan (includes XC polymer)	4,600.0	14,855.0	12,163.0	31,618.0
Magco Foam Chek (l)	-	68.0	-	68.0
Mica	-	1,825.0	4,200.0	6,025.0
Paraformaldehyde	-	113.0	598.0	711.0
Peltex	-	13,492.0	12,334.0	25,826.0
Sawdust	-	468.0	82.0	550.0
Soda Ash	1,751.0	-	2,280.0	4,031.0
Sodium Sulfite	2,925.0	3,250.0	4,450.0	10,625.0
Spersene	1,703.0	22.7	749.0	2,474.7
Techniflo	7,559.0	-	10,978.0	18,537.0
Torq Trim (l)	-	1,845.0	-	1,845.0
Unical	454.0	-	-	454.0
Walnut Hulls	159.0	6,858.0	-	7,017.0

TABLE 4: GULF CANADA RESOURCES INC.

DRILLING FLUID ADDITIVE USE BY WELL

(all measures are in kg unless otherwise indicated)

Chemical	Akpak P-35	Amauligak J-44	Pitsiulak A-05	Tarsiut P-45	Total
AP-21	3,525.0	8,250.0	450.0	11,275.0	23,500.0
Bardac 2250 (l)	200.0	-	200.0	400.0	800.0
Barite (tonnes)	401.0	516.0	1,143.0	502.0	2,562.0
Bicarbonate of Soda	275.0	820.0	3,375.0	4,500.0	8,970.0
Brine (m^3)[a]	180.0	94.0	28.0	-	302.0
Caustic Soda	2,325.0	8,775.0	-	18,350.0	29,450.0
Drispac (regular and superlo)	4,225.0	6,550.0	2,375.0	7,600.0	20,750.0
DX 10	8,000.0	2,600.0	800.0	18,200.0	29,600.0
Foam Kontrol	-	200.0	200.0	400.0	800.0
IDFlo	6,275.0	10,150.0	5,600.0	9,050.0	31,075.0
KCL/Potash	124,100.0	51,200.0	20,975.0	155,675.0	351,950.0
Lubraglide	-	-	-	1,440.0	1,440.0
Mica	-	-	1,280.0	-	1,280.0
Peltex (Technisperse)	3,675.0	3,600.0	3,300.0	2,050.0	12,625.0
Safeguard 5000 (l)	-	400.0	-	-	400.0
SAPP	-	45.4	363.2	2,724.0	3,132.6
Shale Kontrol	-	6,975.0	-	27,650.0	34,625.0
Soda Ash	7,875.0	7,290.0	5,445.0	7,965.0	28,575.0
Sodium Hydroxide	-	-	1,543.6	-	1,543.6
Sodium Sulfite	250.0	850.0	825.0	-	1,925.0
Torq Kontrol (l)	-	-	-	4,600.0	4,600.0
Walnut Hulls	-	315.0	900.0	3,240.0	4,455.0
XCD (Kelzan)	5,750.0	8,250.0	5,525.0	14,150.0	33,675.0
X-Pel-G	-	-	-	3,200.0	3.200.0

[a] brine is made with approximately 245 to 250 kg per m^3

TABLE 5a: PANARCTIC OIL LTD.

WATER BASED DRILLING FLUID ADDITIVE USE BY WELL

(all measures are in kg unless otherwise indicated)

Additive	Buckingham O-68	Cisco M-22	Skate C-59	Total
Aluminum Stearate	-	-	25.0	25.0
Attapulgite	25,424.0	21,605.0	-	47,104.0
Barite (tonnes)	144.9	301.7	415.9	862.5
Bentonite	15,890.0	3,228.0	54,208.0	73,326.0
B-free (l)	740.0	480.0	360.0	1,580.0
Bicarbonate of Soda	545.0	590.0	-	1,135.0
Caustic Soda	13,875.0	8,575.0	8,350.0	30,800.0
CMC	4,381.0	3,748.0	4,313.0	12,442.0
Coat 129	-	650.0	590.0	1,240.0
Diesel (l)	15,420.0	-	6,000.0	21,420.0
Kelzan XC	14,300.0	6,875.0	12,100.0	33,275.0
Kwik Seal (Imco Fibre)	-	-	37,600.0	37,600.0
Lignite	-	2,477.0	3,405.0	5,882.0
Mica	-	-	20,475.0	20,475.0
Nickel Salt	-	-	91.0	91.0
Nickel Sulphate	45.0	-	-	45.0
Salt	3,723.0	7,272.0	1,294.0	12,289.0
Sawdust	-	2,687.0	30,400.0	33,087.0
Spersene	2,474.0	-	-	2,474.0
Staflo	3,110.0	1,275.0	4,400.0	8,785.0
Surflo H35 (l)	-	160.0	65.0	225.0
Tannithan	-	909.0	-	909.0
Torque Less Beads	136.0	-	-	136.0
Turbo Al (l)	-	1,500.0	-	1,500.0
Walnut Hulls	-	-	3,042.0	3,042.0
Zeogel	-	-	44,582.0	44,582.0

TABLE 5b: PANARCTIC OILS LTD.

DIESEL OIL-BASED DRILLING FLUID ADDITIVES

(all measures are in kg unless otherwise indicated)

ADDITIVE	CISCO M-22
Barite (tonnes)	39.8
Lime	3,480.0
Normul (1)	2,080.0
Primul (1)	936.0
Technireg (1)	1,664.0
Technisurf	120.0
Technivis	2,840.0
Turbo A-1 (1)	83,700.0

The oil based "mud" was discharged into containers mand transported to a land based disposal site for incineration.

COMPARISON OF ESTIMATED AND ACTUAL QUANTITIES

OF DRILLING FLUID ADDITIVES USED

TABLE 6a: DOME PETROLEUM LIMITED DRILLING FLUID ADDITIVE

COMPARISON OF ESTIMATED AND ACTUAL USE

(all measures are in kg unless otherwise indicated)

Additive	Estimated use	Actual use
Aluminum Stearate	As Required (A.R.)	125.0
AP 21 (l)	28,000.0	23,600.0
AP 21 solid[a]	-	1,200.0
Barite (tonnes)	22,000.0	8,828.0
Bentonite	50,000.0	177,114.0
B-free (l)	A.R.	208.0
Bicarbonate of Soda	20,000.0	11,117.0
Brine (l)	-	105,000.0
Caustic Soda	215,000.0	62,993.0
Defoamer (l)	-	2,050.0
Densimix	83,000.0	50,000.0
Desco	27,000.0	4,683.0
Drispac/Staflo Reg.	15,000.0	5,305.0
Drispac Superlo	82,000.0	25,038.0
DX-10 (l)	A.R.	21,648.0
FLR-100	A.R.	100.0
Foam Kontrol (l)	A.R.	9,144.0
IDF lo	87,000.0	22,950.0
IDF Thin	350,000.0	47,626.0
KCl	1,602,000.0	399,400.0
Kelzan (XC, XCD)	A.R.	12,454.0
Kwik Seal	A.R.	14,389.0
Magconol (l)	A.R.	2,288.0
Mica	A.R.	16,197.0
N'oxygen	A.R.	1,612.0
Nut Plug	A.R.	658.0
Poly R_x	28,000.0	8,532.0
SAPP	A.R.	1,906.0
Shale Kontrol	A.R.	3,750.0
Soda Ash	48,000.0	19,151.0
Sodium Sulfite	A.R.	1,592.0
Soltex	A.R.	3,425.0
SST (l)	135,000.0	26,809.0
Staflo X-Lo	A.R.	17,079.0
Technisperse	-	99,343.0
Torqless Beads	A.R.	1,611.0
Torq Control (l)	-	7,280.0
Torq Trim	18,000.0	33,534.0
Walnut Hulls	-	10,175.0
X-Pel-G	-	11,753.0

NOTE: Dome did not provide individual well estimates

[a] may have been included in estimate of AP21 liquid above

TABLE 6b: DOME PETROLEUM LIMITED
PERCENTAGE DIFFERENCES BETWEEN ESTIMATED AND ACTUAL ADDITIVE USE

ADDITIVE	OVERALL[2]
Aluminum Stearate	100.00
AP 21 liquid	-18.64
AP 21 solid	100.00
Barite	-149.20
Bentonite	71.77
B-free	100.00
Bicarbonate of Soda	-79.90
Brine	100.00
Caustic Soda	-241.30
Defoamer	100.00
Densimix	-66.00
Desco	-476.60
Drispac/Staflo Reg.	-182.80
Drispac Superlo	-227.50
DX-10	100.00
FLR-100	100.00
Foam Kontrol	100.00
IDFlo	-279.10
IDF Thin	-634.90
KCl	-301.10
Kelsan (XD, XCD)	100.00
Kwik Seal	100.00
Magconol	100.00
Mica	100.00
N'oxygen	100.00
Nut Plug	100.00
Poly R_x	-228.20
SAPP	100.00
Shale Kontrol	100.00
Soda Ash	-150.60
Sodium Sulfite	100.00
Soltex	100.00
SST	-403.60
Staflo X-Lo	100.00
Technisperse	100.00
Torqless Beads	100.00
Torq Control	100.00
Torq Trim	46.32
Walnut Hulls	100.00
X-Pel-G	100.00
Average	-23.03
Standard Deviation	192.10
Count	40

[1]Calculated as ((Actual-Estimated)/Actual)*100. The Estimated and Actual Values come from the preceding Table 6a.

[2]Dome did not provide individual well estimates. If an additive was listed as A.R. in Table 6a its value for this calculation = 0.

TABLE 7a: ESSO RESOURCES CANADA LIMITED

COMPARISON OF ESTIMATED AND ACTUAL DRILLING

FLUID ADDITIVE USE BY WELL

(all measures are in kg unless otherwise indicated)

Additive	Adgo H-29		Amerk O-09		Nipterk L-19	
	Estimated	Actual	Estimated	Actual	Estimated	Actual
Aluminum Stearate	600.0	50.0	600.0	622.7	600.0	580.0
Barazan	-	-	-	-	-	589.0
Barite (tonnes)	3,060.0	204.0	3,740.0	2,108.0	3,060.0	1,102.0
Bentonite	96,000.0	12,122.0	128,000.0	53,195.0	96,000.0	18,158.0
B-free (l)	-	1,045.0	-	120.0	-	5,581.0
Bicarbonate of Soda	11,200.0	5,176.0	12,800.0	2,675.0	11,200.0	9,757.0
Capryl Alcohol (l)	655.0	-	655.0	-	655.0	-
Caustic Soda	44,800.0	8,450.0	54,400.0	25,770.0	44,800.0	20,284.0
CMC	-	50.0	-	-	-	1,900.0
Diesel (l)	-	60,411.0	-	-	-	36,262.0
Drispac - regular	12,000.0	2,088.0	14,400.0	6,162.0	12,000.0	21,013.0
- superlo	3,000.0	-	3,000.0	4,994.0	3,000.0	-
IDFlo	48,000.0	-	57,600.0	22,325.0	48,000.0	13,365.0
KCL	32,000.0	27,250.0	32,000.0	59,851.0	32,000.0	12,150.0
Kelzan (includes XC Polymer)	32,000.0	4,600.0	41,400.0	14,855.0	32,000.0	12,163.0
Magco Foam Chek (l)	3,000.0	-	3,000.0	68.0	3,000.0	-
Mica	-	-	-	1,825.0	-	4,200.0
Paraformaldehyde	-	-	-	113.0	-	598.0
Peltex	19,200.0	-	55,000.0	13,492.0	19,200.0	12,334.0
Sawdust	-	-	-	468.0	-	82.0
Soda Ash	3,200.0	1,751.0	3,200.0	-	3,200.0	2,280.0
Sodium Sulfite	16,000.0	2,925.0	18,600.0	3,250.0	16,000.0	4,450.0
Spersene	-	1,703.0	-	22.7	-	749.0
Staflo Ex-lo	2,000.0	-	-	-	2,000.0	-
Techniflo	48,000.0	7,559.0	57,600.0	-	48,000.0	10,978.0
Torq Trim (l)	-	-	-	1,845.0	-	-
Unical	10,000.0	454.0	25,000.0	-	10,000.0	-
Walnut Hulls	-	159.0	-	6,858.0	-	-

TABLE 7b: ESSO RESOURCES CANADA LIMITED
PERCENTAGE DIFFERENCES BETWEEN ESTIMATED AND ACTUAL ADDITIVE USE

ADDITIVE	ADGO H-29	AMERK O-09	NIPTERK L-19
Aluminum Stearate	-1100.00	3.65	3.45
Barazan	N/A	N/A	100.00
Barite	-1400.00	-77.42	-177.70
Bentonite	-691.90	-140.60	-428.70
B-free	100.00	100.00	100.00
Bicarbonate of Soda	-116.40	-378.50	-14.79
Capryl Alcohol	N/U	N/U	N/U
Caustic Soda	-430.20	-111.10	-120.90
CMC	100.00	N/A	100.00
Diesel	100.00	N/A	100.00
Drispac - regular	-474.70	-133.70	42.89
- superlo	N/U	39.93	N/U
IDFlo	N/U	-158.00	-259.10
KCl	-17.43	46.53	-163.40
Kelzan (includes XC Polymer)	-595.70	-17.87	-163.10
Magco Foam Chek	N/U	-4312.00	N/U
Mica	N/A	100.00	100.00
Paraformaldehyde	N/A	100.00	100.00
Peltex	N/U	-307.60	-55.67
Sawdust	N/A	100.00	100.00
Soda Ash	-82.75	N/U	40.35
Sodium Sulfite	-477.00	-472.30	-259.60
Spersene	100.00	100.00	100.00
Staflo Ex-lo	N/U	N/A	N/U
Techniflo	-535.00	N/U	-337.20
Torq Trim	N/A	100.00	N/A
Unical	-2103.00	N/U	N/U
Walnut Hulls	100.00	100.00	N/A
Average	-440.80	-274.00	-56.24
Standard Deviation	616.88	966.21	166.11
Count	17	20	21
OVERALL AVERAGE		-244.00	
OVERALL STANDARD DEVIATION		672.71	

[1]Calculated as ((Actual-Estimated)/Actual)*100. The Estimated and Actual Values come from the preceeding Table 7a.

N/A - Not applicable
N/U - Planned for but not used (not included in calculation of average or standard deviation).

TABLE 8a: GULF CANADA RESOURCES INC.

COMPARISON OF ESTIMATED AND ACTUAL DRILLING FLUID ADDITIVE USE BY WELL

(all measures are in kg unless otherwise indicated)

Additive	Typical Kulluk Well (Estimated)	Akpak P-35	Amauligak J-44	Pitsiulak A-05	Tarsuit P-45 Estimated	Tarsuit P-45 Actual
AP-21	17,400.0	3,525.0	8,250.0	450.0	8,325.0	11,275.0
Bardac 2250 (l)	-	200.0	-	200.0	-	400.0
Barite (tonnes)	779.0	401.0	516.0	1,143.0	874.0	502.0
Bicarbonate of Soda	2,025.0	275.0	820.0	3,375.0	1,170.0	4,500.0
Brine (m^3)[a]	-	180.0	94.0	28.0	-	-
Caustic Soda	36,850.0	2,325.0	8,775.0	-	19,025.0	18,350.0
Drispac (reg & superlo)	10,114.0	4,225.0	6,550.0	2,375.0	4,425.0	7,600.0
DX 10	23,000.0	8,000.0	2,600.0	800.0	11,800.0	18,200.0
Foam Kontrol	1,000.0	-	200.0	200.0	600.0	400.0
IDFlo	22,375.0	6,275.0	10,150.0	5,600.0	11,475.0	9,050.0
KCL/Potash	209,300.0	124,100.0	51,200.0	20,975.0	63,350.0	155,675.0
Lubraglide	-	-	-	-	-	1,440.0
Mica	-	-	-	1,280.0	-	-
Peltex (Technisperse)	47,225.0	3,675.0	3,600.0	3,300.0	22,575.0	2,050.0
Safeguard 5000 (l)	-	-	400.0	-	-	-
SAPP	-	-	45.4	363.2	-	2,724.0
Shale Kontrol	66,750.0	-	6,975.0	-	34,475.0	27,650.0
Soda Ash	4,185.0	7,875.0	7,290.0	5,445.0	2,205.0	7,965.0
Sodium Hydroxide	-	-	-	1,543.6	-	-
Sodium Sulphite	1,825.0	250.0	850.0	825.0	950.0	-
Torq Kontrol (l)	-	-	-	-	-	4,600.0
Walnut Hulls	-	-	315.0	900.0	-	3,240.0
XCD (Kelzan)	16,050.0	5,750.0	8,250.0	5,525.0	10,950.0	14,150.0
X-Pel-G	-	-	-	-	-	3,200.0

NOTE: No individual estimated chemical use were given for the Akpak P-35, Amauligak J-44 and Pitsiulak A-05 wells. For chemical use estimates use the "Typical Kulluk Well" values.

[a] brine made with 245-250 kg KCL per m^3

TABLE 8b: GULF CANADA RESOURCES INC.
PERCENTAGE DIFFERENCES BETWEEN ESTIMATED AND ACTUAL ADDITIVE USE

ADDITIVE	AKPAK P-35	AMAULIGAK J-44	PITSIULAK A-05	TARSIUT P-43
AP-21	-393.60	-110.90	-3767.00	26.16
Bardac 2250	100.00	N/A	100.00	100.00
Barite	-94.26	-50.97	31.85	-74.10
Bicarbonate of Soda	-636.40	-147.00	40.00	74.00
Brine	100.00	100.00	100.00	N/A
Caustic Soda	-1485.00	-319.90	N/U	-3.68
Drispac (reg & superlo)	-139.40	-54.41	-325.90	41.78
DX 10	-187.50	-784.60	-2775.00	35.17
Foam Kontrol	N/U	-400.00	-400.00	-50.00
IDFlo	-256.60	-120.40	-299.60	-26.80
KCl/Potash	-68.65	-308.80	-897.90	-59.31
Lubraglide	N/A	N/A	N/A	100.00
Mica	N/A	N/A	100.00	N/A
Peltex (Technisperse)	-1185.00	-1212.00	-1313.00	-1001.00
Safeguard 5000	N/A	100.00	N/A	N/A
SAPP	N/A	100.00	100.00	100.00
Shale Kontrol	N/U	-857.00	N/U	-24.68
Soda Ash	46.86	42.59	23.14	72.32
Sodium Hydroxide	N/A	N/A	100.00	N/A
Sodium Sulphite	-630.00	-114.70	-121.20	N/U
Torq Kontrol	N/A	N/A	N/A	100.00
Walnut Hulls	N/A	100.00	100.00	100.00
XCD (Kelzan)	-179.10	-94.55	-190.50	22.62
X-Pel-G	N/A	N/A	N/A	100.00
Average	-357.80	-229.60	-522.90	-13.15
Standard Deviation	477.38	371.43	1085.00	248.73
Count	14	18	18	19
OVERALL AVERAGE		-272.50		
OVERALL STANDARD DEVIATION		652.50		

[1]Calculated as ((Actual-Estimated)/Actual)*100. The Estimated and Actual Values come from the preceeding Table 8a.

N/A - not applicable
N/U - planned but not used (Not included in calculation of average or standard deviation)

TABLE 9a: PANARCTIC OIL LTD.

DRILLING ADDITIVE

COMPARISON OF ESTIMATED AND ACTUAL USE BY WELL

(all measures are in kg unless otherwise indicated)

	Buckingham O-68		Cisco M-22		Skate C-59	
Additive	Estimated	Actual	Estimated	Actual	Estimated	Actual
Aluminum Stearate	-	-	-	-	-	25.0
Attapulgite Gel (includes salt gel)	28,300.0	25,424.0	18,000.0	21,605.0	26,000.0	-
Barite (tonnes)	148.0	144.9	200.0	301.7	140.0	415.9
Bentonite	30,000.0	15,890.0	51,000.0	3,228.0	28,000.0	54,208.0
Bi-free (l)	1,025.0	740.0	2,870.0	480.0	2,870.0	360.0
Bicarbonate of Soda	1,200.0	545.0	2,300.0	590.0	1,300.0	-
Caustic Soda	18,700.0	13,875.0	20,000.0	8,575.0	20,000.0	8,350.0
Chrom Alum	-	-	3,000.0	-	-	-
CMC	1,100.0	4,381.0	1,100.0	3,748.0	1,100.0	4,313.0
Coat 129	-	-	158.0	650.0	-	590.0
Coat 888	-	-	45.0	-	-	-
Diesel (l)	-	15,420.0	-	-	-	6,000.0
Kelzan XC	15,000.0	14,300.0	17,500.0	6,875.0	15,000.0	12,100.0
Kwik Seal (Imco Fybre)	4,400.0	-	2,800.0	-	3,200.0	37,600.0
Lignite	-	-	1,500.0	2,477.0	3,400.0	3,405.0
Lime	960.0	-	1,400.0	3,480.0	360.0	-
Mica	-	-	6,200.0	-	-	20,475.0
Nickel Salt	-	-	-	-	-	91.0
Nickel Sulphate	-	45.0	-	-	-	-
Normul (l)	-	-	-	2,080.0	-	-
Primul (l)	-	-	-	936.0	-	-
Salt	4,000.0	3,723.0	10,500.0	7,272.0	900.0	1,294.0
SAPP	-	-	2,300.0	-	450.0	-
Sawdust	8,600.0	-	7,500.0	2,687.0	4,900.0	30,400.0
Soda Ash	-	-	-	-	300.0	-
Spersene	-	2,474.0	3,300.0	-	25.0	-
Staflo	-	3,110.0	5,000.0	1,275.0	150.0	4,400.0
Surflo H35 (l)	-	-	77.0	160.0	-	65.0
Tannithan	-	-	-	909.0	-	-
Technireg (l)	-	-	-	1,664.0	-	-
Technisurf (l)	-	-	-	120.0	-	-
Technivis (l)	-	-	-	2,840.0	-	-
Torqueless Beads	-	136.0	-	-	-	-
Turbo A-1 (l)	-	-	-	85,200.0	-	-
Walnut Hulls	2,000.0	-	600.0	-	1,500.0	3,042.0
Zeogel	-	-	-	-	-	44,582.0

TABLE 9b: PANARCTIC OILS LIMITED
PERCENTAGE DIFFERENCES BETWEEN ESTIMATED AND ACTUAL ADDITIVE USE

ADDITIVE	BUCKINGHAM O-68	CISCO M-22	SKATE C-59
Aluminum Stearate	N/A	N/A	100.00
Attapulgite Gel (includes salt gel)	-11.31	16.69	N/U
Barite	-2.14	33.71	66.34
Bentonite	-88.80	-1480.00	48.35
B-free	-38.51	-497.90	-697.20
Bicarbonate of Soda	-120.20	-289.80	N/U
Caustic Soda	34.77	-133.20	-139.50
Chrom Alum	N/A	N/U	N/A
CMC	74.89	70.65	74.50
Coat 129	N/A	75.69	100.00
Coat 888	N/A	N/U	N/A
Diesel	100.00	N/A	100.00
Kelzan XC	-4.90	-154.50	-23.97
Kwik Seal (Imco Fybre)	N/U	N/U	91.49
Lignite	N/A	39.44	0.150
Lime	N/U	59.77	N/U
Mica	N/A	N/U	100.00
Nickel Salt	N/A	N/A	100.00
Nickel Sulphate	100.00	N/A	N/A
Normul	N/A	100.00	N/A
Primul	N/A	100.00	N/A
Salt	-7.44	-44.39	30.45
SAPP	N/A	N/U	N/U
Sawdust	N/U	-179.10	83.88
Soda Ash	N/A	N/A	N/U
Spersene	100.00	N/U	N/U
Staflo	100.00	-292.20	96.59
Surflo H35	N/A	51.88	100.00
Tannithan	N/A	100.00	N/A
Technireg	N/A	100.00	N/A
Technisurf	N/A	100.00	N/A
Technivis	N/A	100.00	N/A
Torqueless Beads	100.00	N/A	N/A
Turbo A-1	N/A	100.00	N/A
Walnut Hulls	N/U	N/U	50.69
Zeogel	N/A	N/A	100.00
Average	19.06	-91.97	20.09
Standard Deviation	76.34	350.99	183.84
Count	14	22	19
OVERALL AVERAGE		-25.00	
OVERALL STANDARD DEVIATION		252.26	

[1]Calculated as ((Actual-Estimated)/Actual)*100. The Estimated and Actual Values come from the preceeding Table 9a.

N/A - Not applicable
N/U - Planned for but not used (not included in calculation of average or standard deviation).

DRILLING WASTE VOLUMES BY WELL

TABLE 10: DOME PETROLEUM LIMITED

DRILLING WASTE SUMMARY BY WELL

(all measures are in cubic metres)

Well	Cuttings/ Solids Control[a]	Mud	Hydraulic Fluid[b]	Other	Total
Aiverk 2I-45	95.56	510.0	10.0	12.0[b]	627.56
Arluk E-90	644.70	411.0[c]	-	-	1,055.70
Havik B-41	3,768.88	882.1	58.0	17.0[b]	4,725.98
Natiak O-44	679.36	67.0	5.0	-	751.36
Nerlerk J-67	2,419.00	235.0	-	-	2,654.00
Siuluk I-05	337.00	415.0	21.0	-	773.00
Total	7,944.50	2,520.1	94.0	29.0	

[a] indicated by the company as "Drilling Wastes Discharged" or as "Solids Removal"

[b] water flow encountered; formation water

c includes 78m^3 of old mud from previous season

TABLE 11: ESSO RESOURCES CANADA LIMITED

DRILLING WASTE SUMMARY BY WELL

(all measures are in cubic metres)

Well	Cuttings	Solids Control	Mud	Other	Total
Adgo H-29	294.2	328.0	201.0	32.9[a]	856.1
Amerk O-09	b	2,103.2	1,016.4	14.3[c]	3,133.9
Nipterk L-19	b	1,447.0	568.1	41.8[d]	2,056.9
Total	294.2	3,878.2	1,785.5	89.0	

[a] includes 4 pills of Diesel and B-free

[b] was not differentiated from Solids Control

[c] includes 2 pills of Diesel and Torque Trim

[d] includes 8 pills of Diesel and B-free

TABLE 12: GULF CANADA RESOURCES INC.

DRILLING WASTE SUMMARY BY WELL

(all measures are in cubic metres)

Well	Cuttings	Solids Control	Mud	Other	Total
Akpak P-35	433.6	553.0	922.0	-	1,908.6
Amauligak J-44	138.0	266.0	1,191.0[a]	-	1,595.0
Pitsiulak A-05	87.8	214.5	666.0[b]	8.0[c]	976.3
Tarsuit P-45	439.5	890.0	1,469.5[d]	62.0[e]	2,861.0
Total	1,098.9	1,923.5	4,248.5	70.0	

[a] includes 2m^3 lost in testing

[b] includes 26m^3 lost in testing

[c] viscous pill

[d] includes 26m^3 lost in testing

[e] viscous sweeps, seawater, produced water

TABLE 13: PANARCTIC OILS LTD.

DRILLING WASTE SUMMARY BY WELL

(all measures are in cubic metres)

Well Name		Cuttings	Solids Control[a]	Mud	Other	Hydraulic Fluids	Totals
Buckingham	O-68	183.99	1,303.90	825.60	16.14[b]	11.47	2,341.10
Cisco	M-22	187.68	355.29	701.00	-	20.87	1,264.84
Skate	C-59	144.33	272.54	477.55	6.36[c]	32.63	933.41
Total		456.00	1,931.73	2,004.15	22.50	64.97	

[a] obtained by adding volumes of desander and desilter

[b] includes pills containing 1. 350 l Diesel ($0.35m^3$) and 2. 15,170 litres of diesel ($15.17m^3$) and 620 litres B-free ($0.62\ m^3$)

[c] includes 6,000 litres diesel ($6m^3$) and 360 litres of B-free ($0.36\ m^3$)

TABLE 14: MAJOR DRILLING FLUID ADDITIVES

WITH TOXICITY (LC_{50}) OF 1000 PPM OR LESS

DISCHARGED INTO ARCTIC MARINE WATERS NORTH OF 60^{o} - 1984

(all measures are in kg unless otherwise noted)

Additive	LC_{50} (96 hr.)	Beaufort Sea	High Arctic	Total
Bardac 2250 (1)	1	800.0	-	800.0
B-free (1)	3.1-7.5	6,954.0	1,580.0	8,534.0
Caustic Soda	105	91,007.0	30,800.0	121,807.0
Desco	105-3750	4,683.0	-	4,683.0
Diesel (1)	1	96,673.0	21,420.0	118,093.0
DX10 (1)	320	51,248.0	-	51,248.0
Foam Kontrol (1)	550	9,944.0	-	9,944.0
Magconol (1)	22-30	2,288.0	-	2288.0
Nickel Sulphate	800	-	45.0	45.0
Nut Plug	800-5500	658.0	-	658.0
Paraformaldehyde	60	711.0	-	711.0
Safeguard 5000 (1)	120	400.0	-	400.0
SAPP	870-1700	5,038.6	-	5,038.6
Soda Ash	75	47,726.0	-	47,726.0
Sodium Hydroxide	10-33	1,543.6	-	1,543.6
Soltex	230	3,425.0	-	3,425.0
Torq Kontrol	160	11,880.0	-	11,880.0
Torq Trim	160	3,5379.0	-	35,379.0
Turbo A-1	1	-	1,500.0	1,500.0
Unical	860	454.0	-	454.0
Walnut Hulls	800	21,647.0	44,582.0	66,229.0

7. APPENDIX III

FIGURES SHOWING LINE OF

BEST FIT FOR SELECTED

DRILLING FLUID ADDITIVE AND WELL DEPTH

TOTAL BARITE USE BY WELL
(ALL WELLS-1983, 1984 SEASONS)

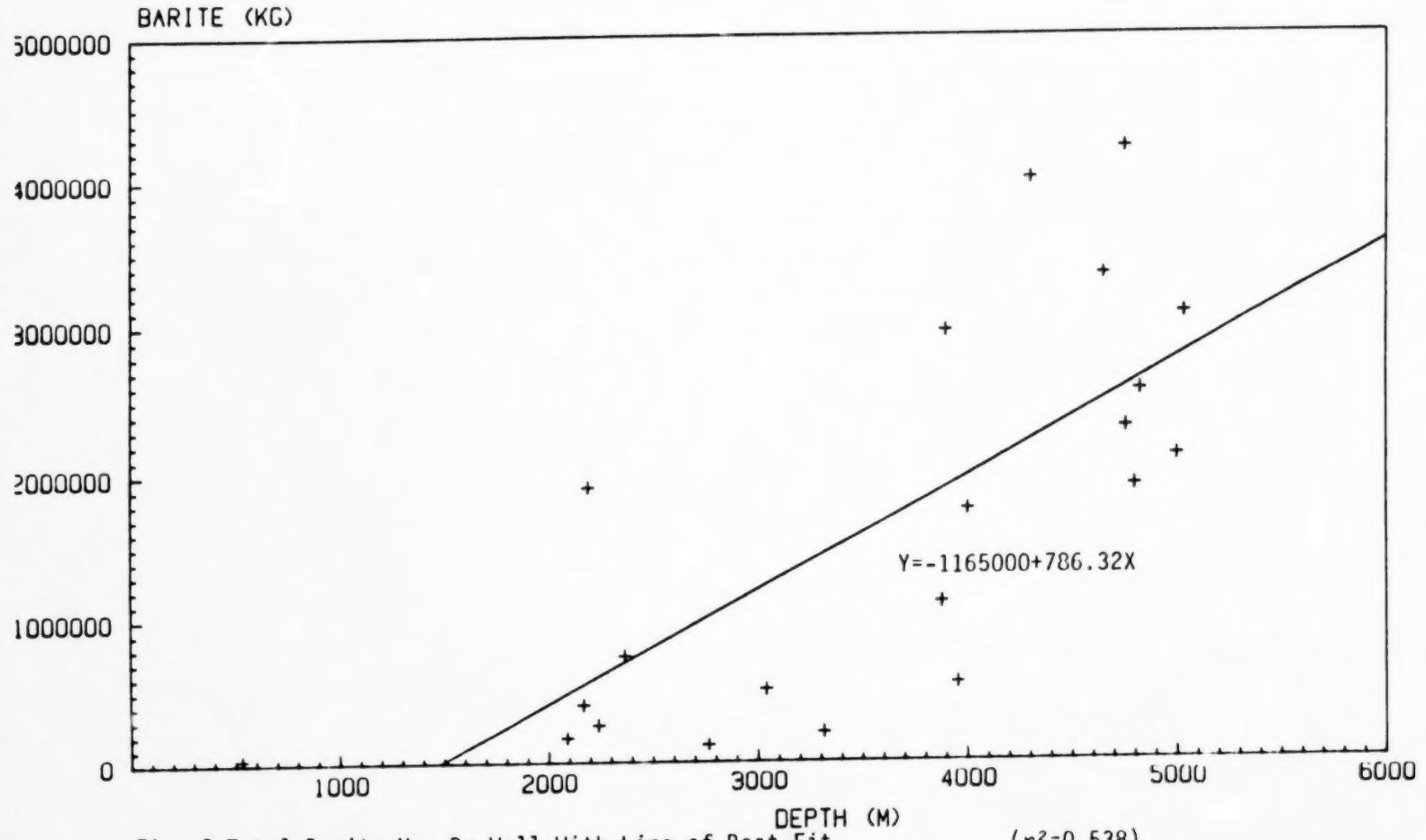


Fig: 3 Total Barite Use By Well-With Line of Best Fit (r^2=0.538)

TOTAL BENTONITE USE BY WELL
(ALL WELLS-1983, 1984 SEASONS)

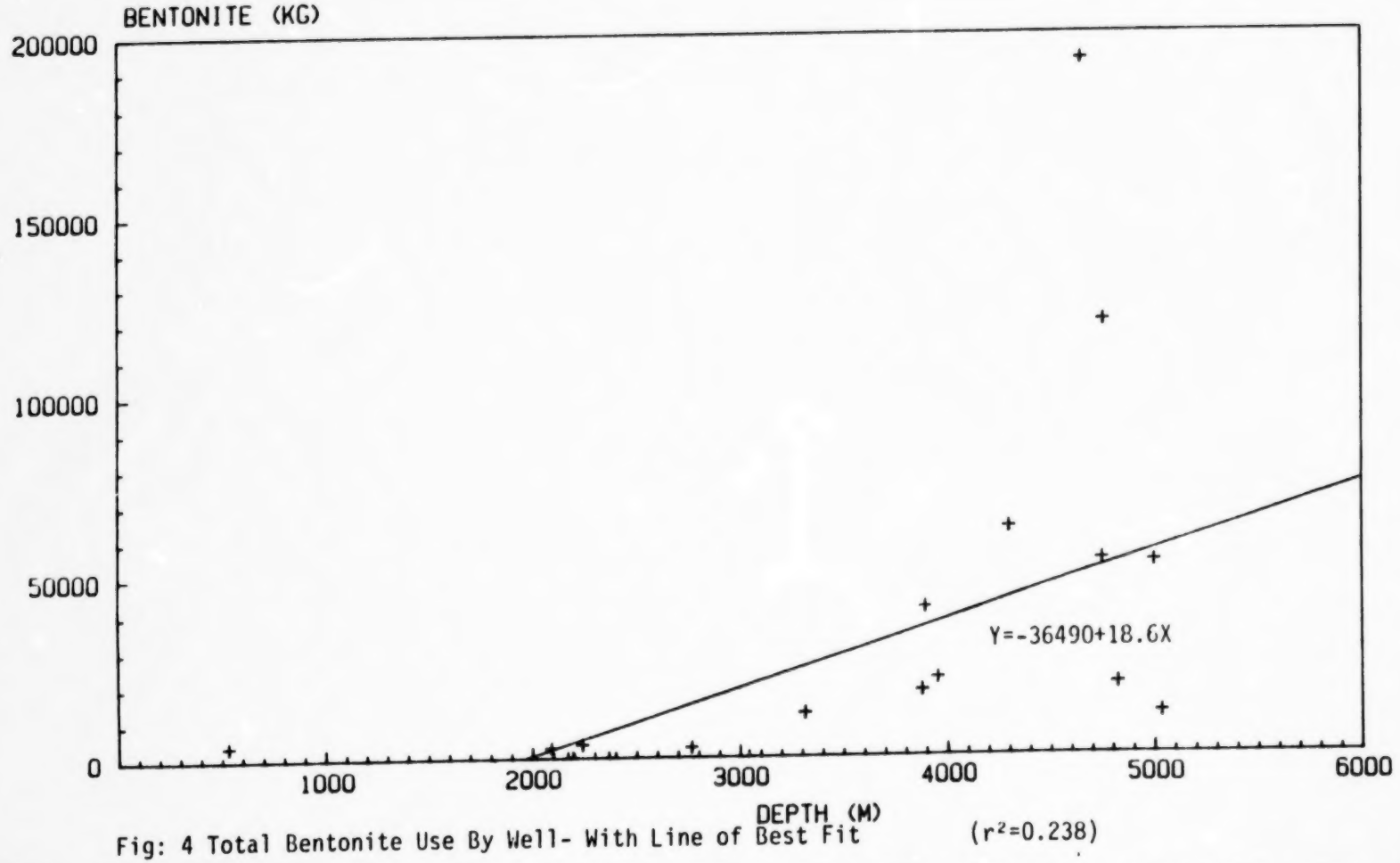


Fig: 4 Total Bentonite Use By Well- With Line of Best Fit (r^2=0.238)

TOTAL CAUSTIC SODA USE BY WELL
(ALL WELLS-1983, 1984 SEASONS)

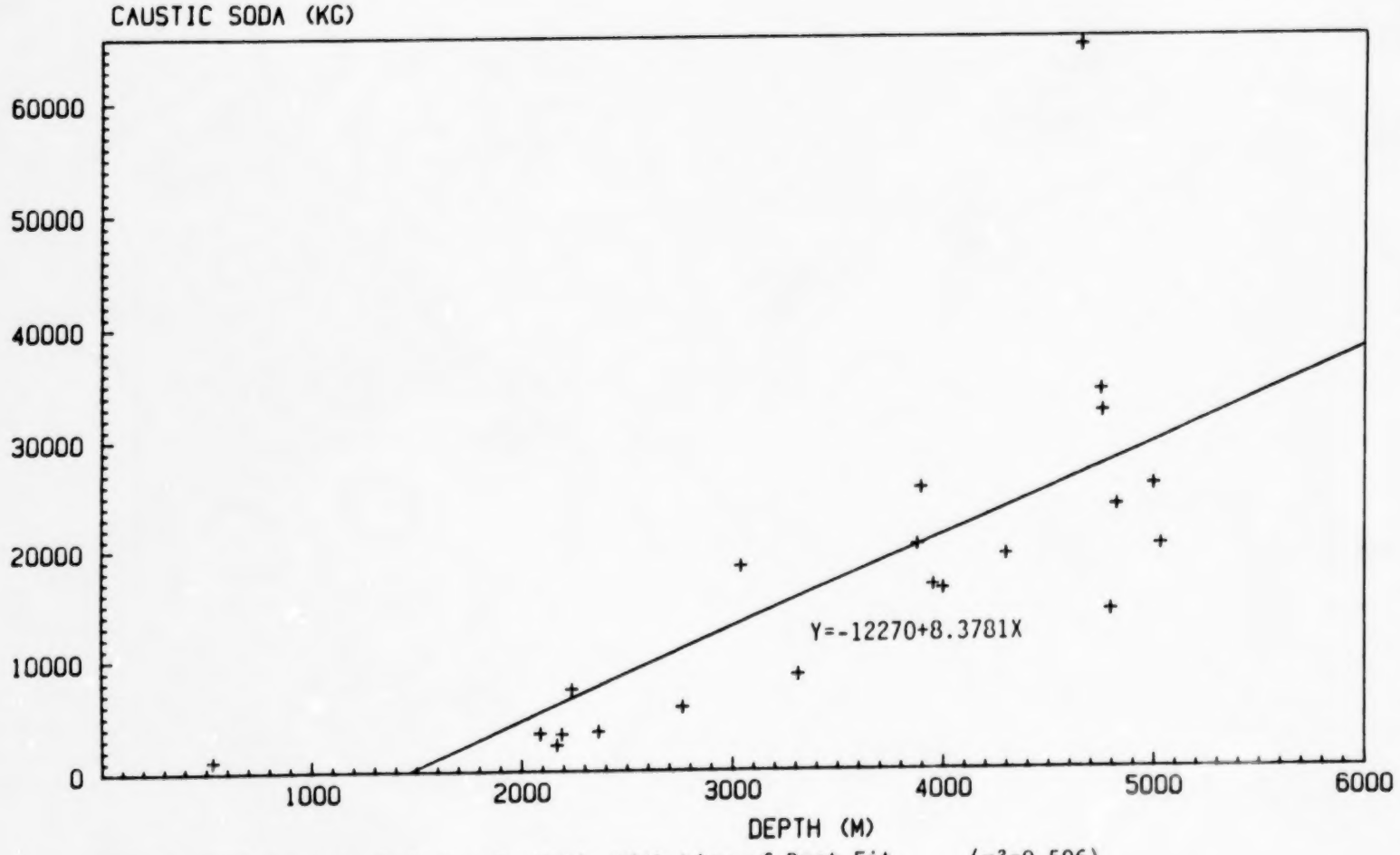


Fig: 5 Total Caustic Soda Use By Well- With Line of Best Fit (r^2=0.506)

TOTAL KCL/POTASH USE BY WELL
(ALL WELLS-1983, 1984 SEASONS)

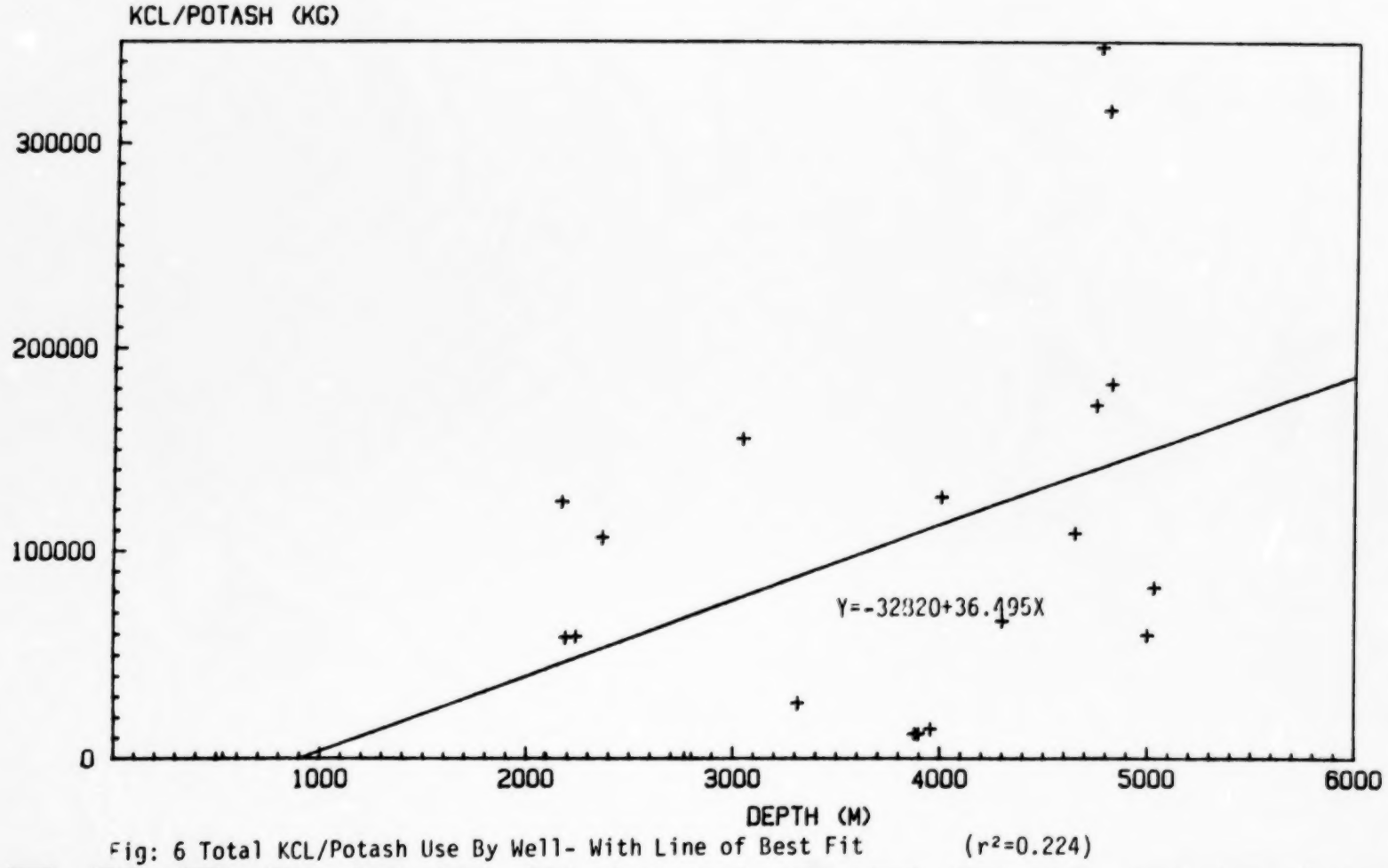


Fig: 6 Total KCL/Potash Use By Well- With Line of Best Fit (r^2=0.224)

TOTAL SODA ASH USE BY WELL
(ALL WELLS-1983, 1984 SEASONS)

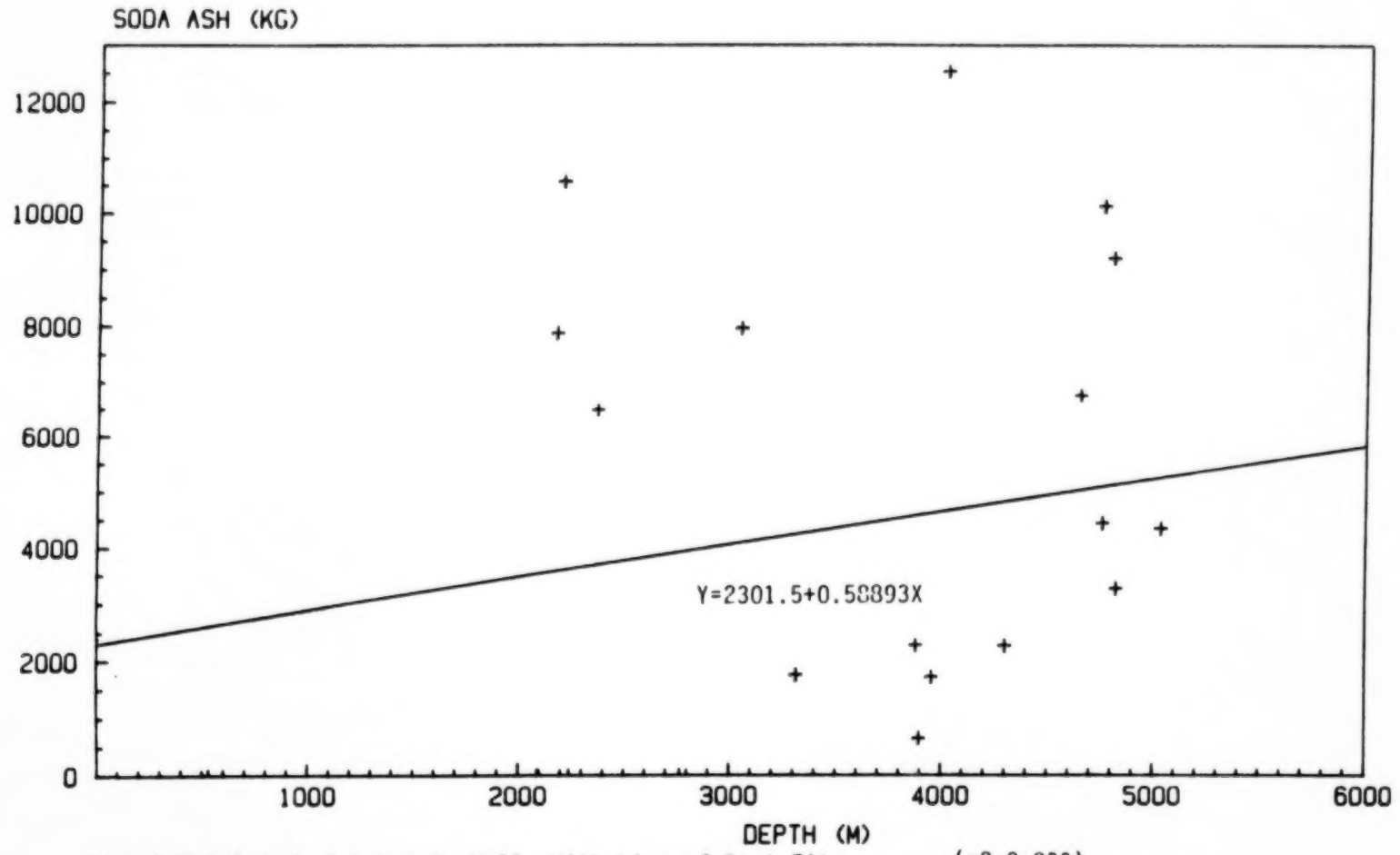


Fig: 7 Total Soda Ash Use By Well- With Line of Best Fit (r2=0.033)

SODIUM BICARBONATE USE BY WELL
(ALL WELLS-1983, 1984 SEASON)

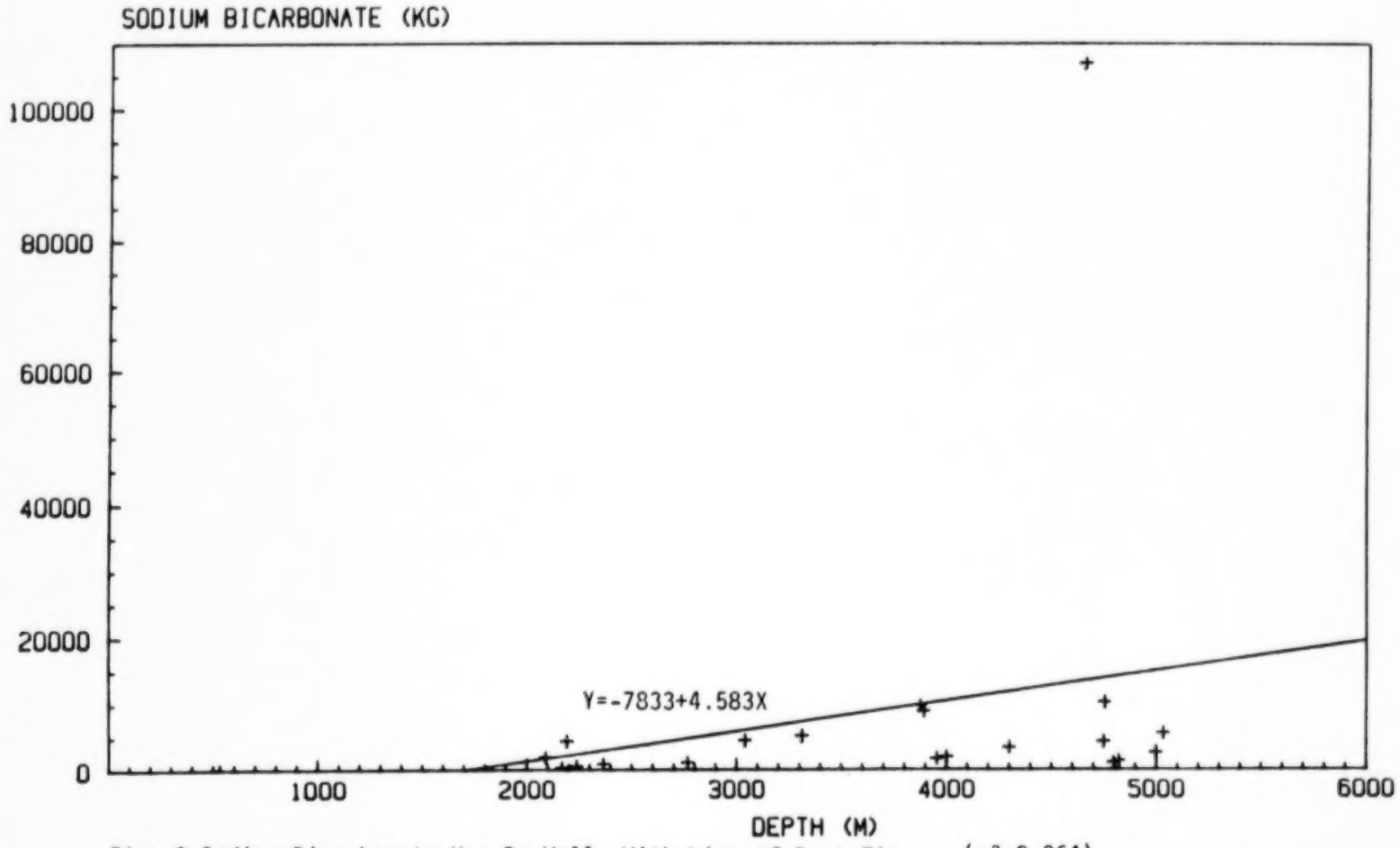


Fig: 8 Sodium Bicarbonate Use By Well- With Line of Best Fit (r^2=0.064)

TOTAL XC POLYMER USE BY WELL
(ALL WELLS-1983, 1984 SEASONS)

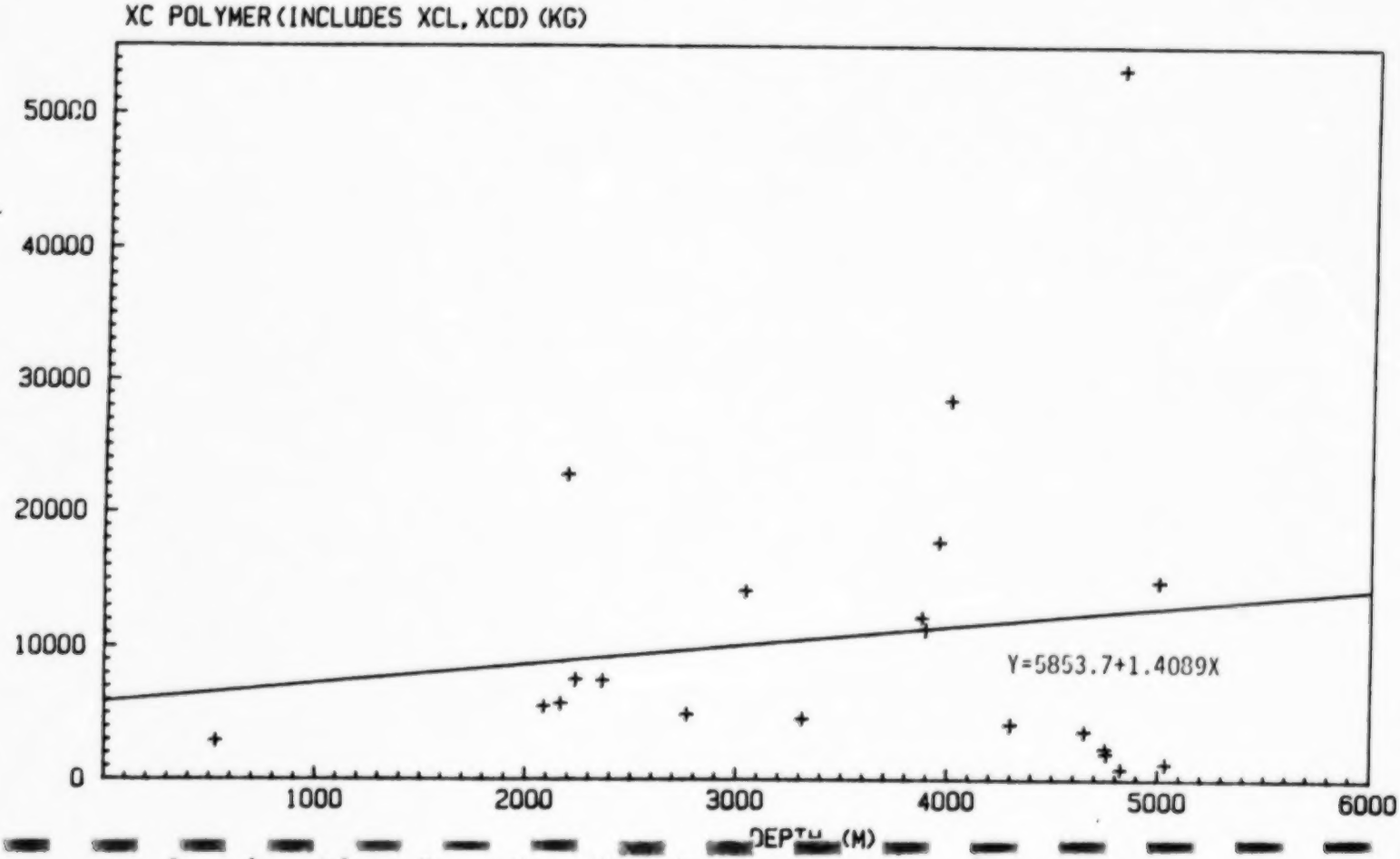


Fig: 9 ... al XC Polymer Use By Well- With Line of Best Fit (r^2=0.021)